AEC RESEARCH and DEVELOPMENT REPORT

BNWL-378

QUARTERLY PROGRESS REPORT
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS
JANUARY 1, 1966-APRIL 1, 1966

R. S. KEMPER
D. P. O'KEEFE

MARCH, 1967

BATTELLE-NORTHWEST
BATTELLE MEMORIAL INSTITUTE / PACIFIC NORTHWEST LABORATORY

BNWL-378
UC-25, Metals, Ceramics,
and Materials

QUARTERLY PROGRESS REPORT
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS
JANUARY 1, 1966-APRIL 1, 1966

By

R. S. Kemper
D. P. O'Keefe
Metallurgy Department

March 1967

Sponsored by the National Aeronautics and Space Administration
Project Management at Washington, D. C.
J. W. Maltz, Office of Advanced Research and Technology

PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U.S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy $3.00; Microfiche $0.65

Previous Quarterly Progress Reports in this series:

HW-83550	April 1, 1964-July 1, 1964
HW-84309	July 1, 1964-October 1, 1964
HW-84550	October 1, 1964-January 1, 1965
BNWL-141	January 1, 1965-April 1, 1965
BNWL-142	April 1, 1965-July 1, 1965
BNWL-162	July 1, 1965-October 1, 1965
BNWL-196	October 1, 1965-January 1, 1966

QUARTERLY PROGRESS REPORT
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS
JANUARY 1, 1966-APRIL 1, 1966

R. S. Kemper
D. P. O'Keefe

INTRODUCTION

Technetium is a sister element to rhenium and has many properties that are similar to rhenium. It is predicted that technetium will have about the same effects on tungsten as rhenium in regard to increase in workability, lowered ductile-to-brittle transition temperature, and improved ductility.

The objectives of the current work are to recover technetium from fission product wastes at Hanford and reduce to purified metal; prepare W-Tc alloys containing up to 50 at.% Tc; fabricate the alloy ingots to sheet stock, assessing the effect of technetium on workability; and perform metallurgical and mechanical property evaluation of the fabricated alloys.

Previous reports have described the separation and purification of 800 g of technetium metal powder, melting of technetium and W-Tc alloys, and some properties of the arc cast alloys.

CURRENT PROGRESS

TEST METHOD DEVELOPMENT

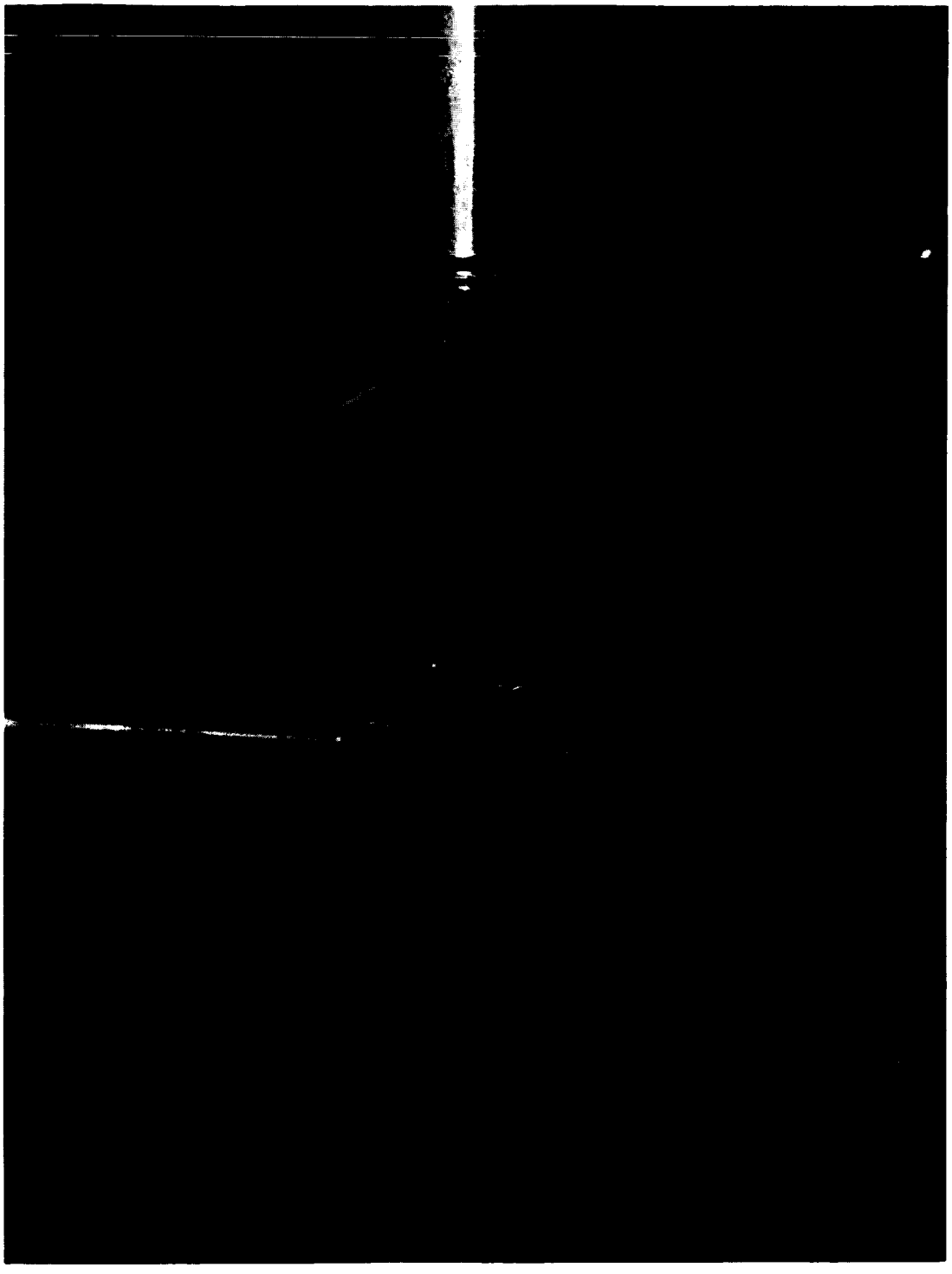
The first fabricated alloys of W-Tc will be in the form of small sheet specimens varying in thickness between 0.020 and 0.050 in. The initial mechanical properties testing to be done on these alloys will be to determine the effect of technetium content on the ductile-brittle transition temperature. A test method is being sought which can be used for

determining this parameter on a very small amount of material. For this purpose a bend test fixture, as shown in Figure 1, has been built. When this fixture is mounted in a test machine, a 3/4 in. long specimen can be loaded as a simple beam. Temperature control is provided with a circulating air oven.

Tests on pure tungsten have shown that the onset of cracking in the bend test specimen is usually adequately indicated by a drop in the test machine load indication. Some specimens of highly wrought tungsten, however, tend to exfoliate, and transverse cracking does not progress far enough in one step to give a clear indication on the load measuring system. Also, it is difficult to fit this type of specimen back together to determine bend angle at the initiation of failure. Therefore, a telescope was built to allow visual sighting of the first crack which in this test appears on the top surface of the specimen. The telescope, shown in Figure 2, provides about 15X magnification at a 12 in. distance.

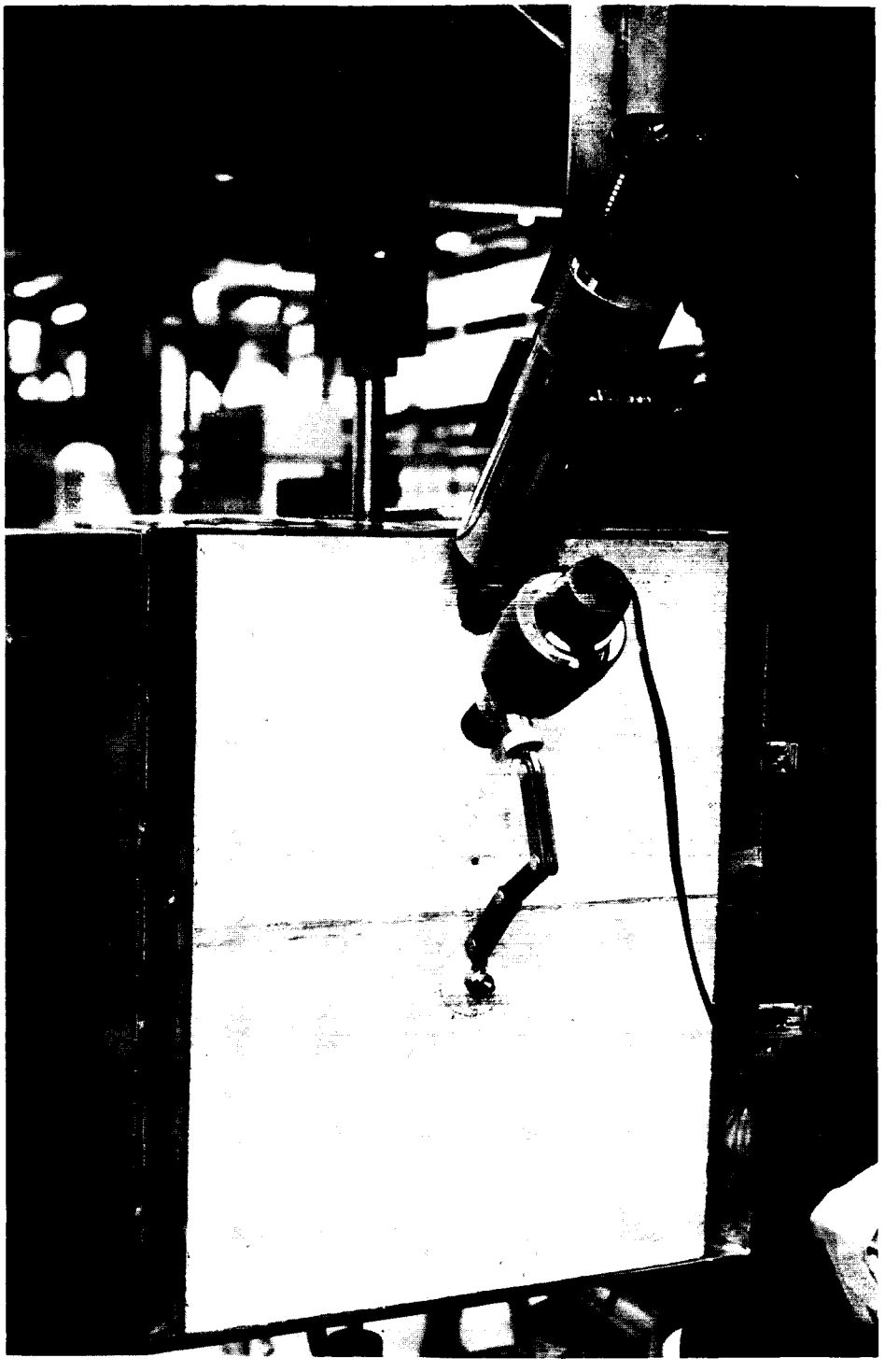
Ductile-brittle transition data for pure tungsten specimens obtained in the process of evaluating the test method are shown in Figure 3. These data were obtained from bend specimen 3/4 x 1/4 in.

The main thing that remains to be done to implement this test method is to establish a procedure for defining the permanent set before fracture in terms of bend angle and thickness.



Neg 0661006-4

FIGURE 1. Bend Test Fixture on Instron Test Machine



Neg 0661006-1

FIGURE 2. Sighting Telescope for Bend Test

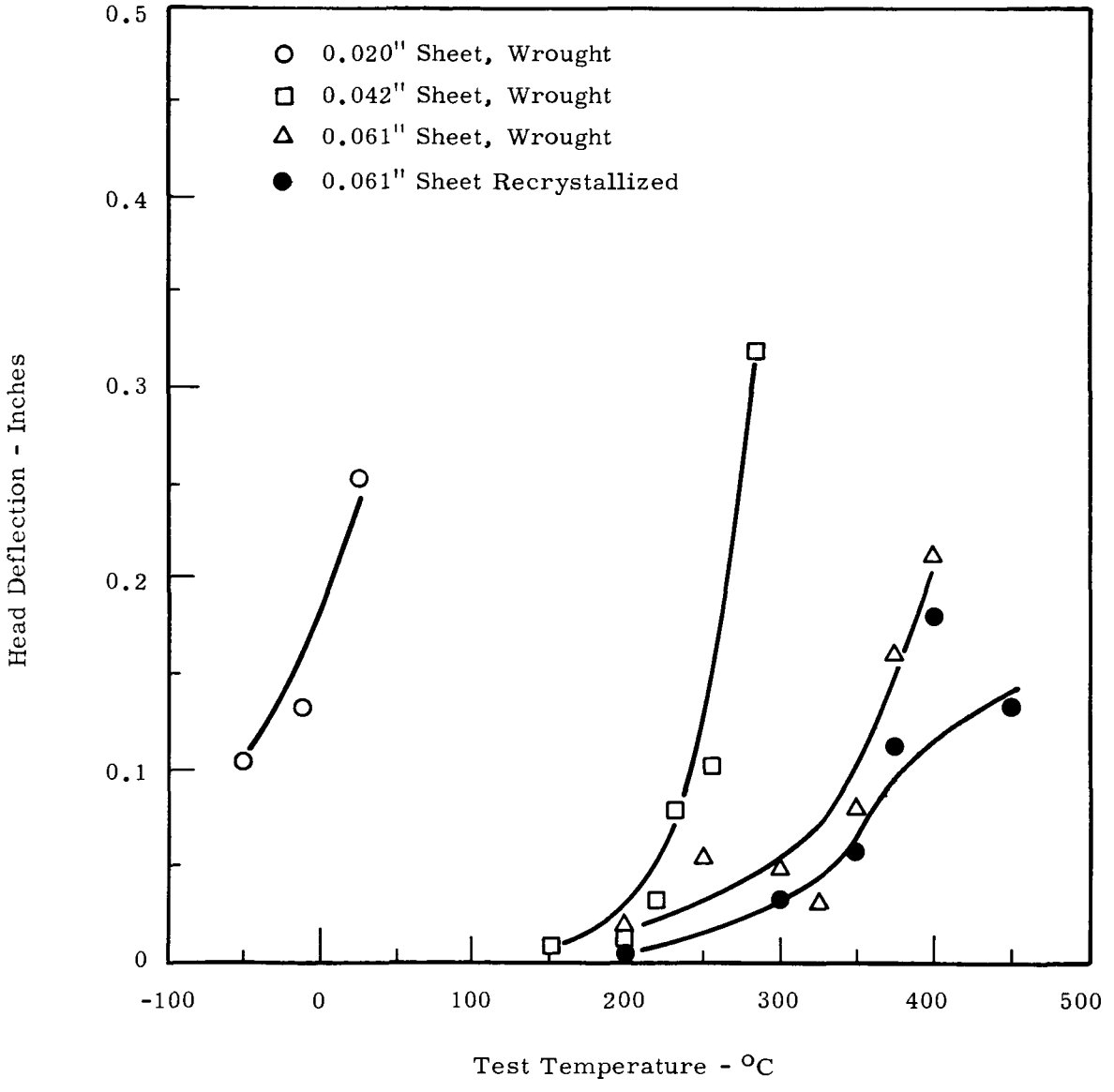


FIGURE 3. Ductile-Brittle Transition Temperatures for Tungsten Sheet Determined by Bend Test. Data points indicate the total deflection imparted to a simple beam to cause fracture.

DISTRIBUTION

No. of Copies	
1	Army Materials Research Agency S. V. Arnold
2	Atomic Energy Commission, Washington Division of Reactor Development and Technology K. Horton
2	Battelle Memorial Institute Defense Metals Information Center R. I. Jaffee
3	Bureau of Mines Department of Interior Washington, D.C. R. F. Stevens, Jr., (Commodity Specialist)
1	Bureau of Naval Weapons Department of Navy Washington, D.C. 20546 T. F. Kearns, (RRMA-2)
1	Chicago Patent Group
1	Climax Molybdenum Company of Michigan 14419 Woodrow Wilson Detroit 38, Michigan M. Semchyschen
277	Division of Technical Information Extension
1	General Electric Company Research Laboratory P. O. Box 1088 Schenectady, New York
4	General Electric Company, Cincinnati L. P. Jahnke (Advanced Engine Technology Dept.) J. A. McGurty E. D. Sayre, (APED) C. S. Wukusick

No. of Copies

1 General Electric Company
Lamp Metal Component Department
Cleveland, Ohio
J. H. Keeler

1 General Electric Company, Richland
GETA File Copy

1 General Telephone and Electronics Laboratories, Inc.
Bayside 60, New York
L. L. Seigle

1 Jet Propulsion Laboratory
Engineering Mechanics Division
H. Martens

1 Lawrence Radiation Laboratory
J. Hadley

1 NASA Ames Research Center
Vehicle Environment Division
Charles A. Hermach

1 NASA Goddard Space Flight Center
Spacecraft Systems Division
H. E. Frankel

1 NASA Langley Research Center
Structures Research Division
E. E. Mathauser

2 NASA Lewis Research Center
W. D. Klopp, (105-1)
N. Saunders, (M&S Div)

1 NASA Manned Spacecraft Center
R. L. Johnston, (S&M Div)

No. of Copies

1 NASA Marshall Space Flight Center
W. R. Lucas, (R-P&VE-M)

2 National Aeronautics and Space Administration
600 Independence Avenue S.W.
Washington, D.C. 20546
Joseph Maltz, (Code RRM)

2 National Aeronautics and Space Administration
Universal North Building
Washington, D.C. 20546
Office of Grants & Research Contracts, (Code SC)

3 Richland Operations Office
C. L. Robinson
R. K. Sharp
Technical Information Library

1 Union Carbide Corporation (ORNL)
Metals and Ceramics
M. L. Picklesimer

1 Universal-Cyclops Steel Corporation
Bridgeville, Pennsylvania
C. P. Mueller

1 Westinghouse Electric Corporation
Research Laboratory
Churchill Boro
Pittsburgh 35, Pennsylvania
J. H. Bechtold

1 Wright-Patterson Air Force Base
Dayton, Ohio
Materials Laboratory
K. Elbaum

No. of Copies

32 Battelle-Northwest

F. W. Albaugh
S. H. Bush
J. J. Cadwell
D. R. de Halas
L. A. Hartcorn
R. N. Johnson
R. S. Kemper
G. A. Last
J. E. Minor (10)
R. L. Moore
D. P. O'Keefe
F. P. Roberts
M. T. Walling
O. J. Wick (2)
F. W. Woodfield
Technical Information Files (5)
Technical Publications (2)